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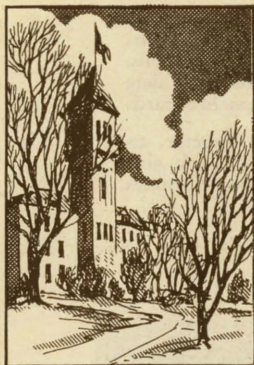
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FARM & HOME SCIENCE



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Vol. 11

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Number 1

NEW INSECTICIDES

What is Their Effect on Bees When
Applied to Flowering Alfalfa?

Scientists Find Insecticide That Will Control Harmful Insects With Minimum Loss of Pollinators

By G. F. KNOWLTON, W. P. NYE, F. V. LIEBERMAN, F. E. TODD, G. E. BOHART

DISCOVERY of the remarkable insect-killing powers of DDT immediately created an "insecticide age." Soon other new and powerful insecticides were developed and marketed. The use of DDT and these newer chemicals was widely encouraged before there had been sufficient opportunity for research workers to learn much about their limitations. Entomologists were particularly alarmed that these spectacular insecticides in commercial use might destroy excessive numbers of beneficial insects. Insofar as bees are concerned this alarm was clearly warranted.

To many crops of fruit and seed, bees are the most important beneficial insects. Alfalfa seed is one of these crops. It is completely dependent upon either honey bees or certain native bees for the cross-pollination essential to profitable seed setting. Growers of alfalfa seed should therefore be vitally concerned in protecting the bees which visit the alfalfa flowers.

All insecticides can kill bees. They must therefore be used wisely at all times, and special effort must be made to avoid the application of dusts or sprays during either day or night to plants in bloom. Research has shown that usually harmful insects can be adequately controlled by applying insecticides before the alfalfa blooms. This

DR. G. F. KNOWLTON is professor of entomology at the Utah Station. W. P. NYE, F. V. LIEBERMAN, F. E. TODD, and DR. G. E. BOHART are entomologists of the U.S. Legume Seed Laboratory and work cooperatively with the Utah Station. Mr. Todd was recently transferred to Tucson, Arizona.

Recommendations For Use Of Insecticides On Seed Alfalfa

1. **Lygus bugs.** When alfalfa is in bud, apply 20 pounds of 10 percent DDT dust per acre or 1.5 pounds of actual DDT per acre as a spray. When full recommended dosage is used, second treatment will usually be unnecessary. When reinfestation warrants a second treatment, apply 20 pounds of 10 percent toxaphene dust per acre or 1.5 pounds of actual toxaphene per acre as a spray. Apply this treatment 3 to 4 weeks after the DDT treatment and only after 7 p.m. or before 7 a.m. when bees are not visiting the blossoms.
2. **Alfalfa weevil.** The control given for lygus is usually adequate for weevil. Growers having difficulty in controlling weevil by that method alone can apply 1.5 pounds of actual chlordane per acre as a water-emulsion spray when the first-crop shoots are 1 inch long.
3. **Grasshoppers.** When the plants are blooming, use only toxaphene at the rates given for lygus control in blooming alfalfa. Before the plants bloom either toxaphene or chlordane may be used.
4. **Aphids, thrips, leafhoppers, and armyworms.** These less important insects are usually adequately controlled by the DDT application recommended for lygus.
5. **Do not feed chaff from crops treated with DDT, chlordane, or toxaphene to dairy animals, to meat animals being fattened for slaughter, or to poultry.**

fact must be accepted as the first rule for chemically controlling insects in seed alfalfa. Control measures that have been recommended to Utah seed growers conform to this principle.

Occasionally, however, an insecticide application may be necessary after the

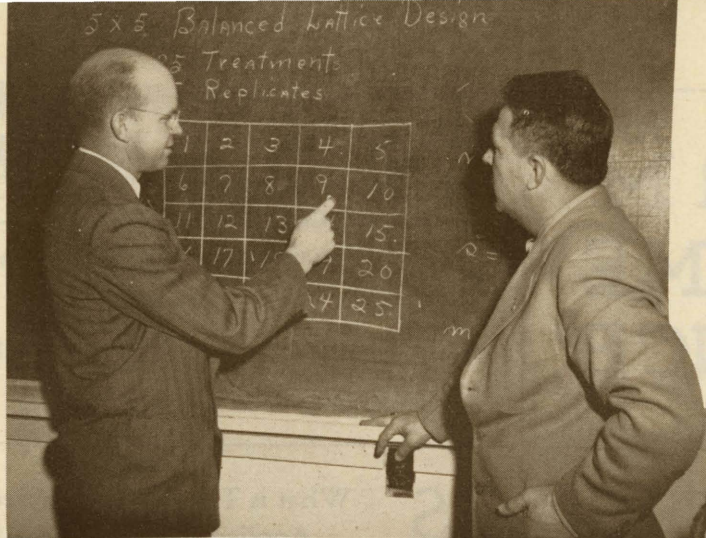
field has come into flower. High reinfestation by lygus may occur, this condition usually being associated with growing of seed on first crop alfalfa. Unanticipated grasshopper infestation may develop. Armyworms may appear. Therefore, there is demand for insecticides that will give adequate control of harmful insects after plants have reached the bloom stage but, at the same time, will not cause economic damage to bees. During the past three years a series of experiments has been conducted in Utah in a search for such insecticides. One has been found that promises to fulfill many of the needs for insect control in flowering alfalfa.

Tests on New Insecticides

Results of numerous tests that have been made against honey bees are summarized in the accompanying table. Included in the experiments were DDT, toxaphene, chlordane, methoxychlor, parathion, lindane, benzene hexachloride, aldrin, and dieldrin. The latter two insecticides have been developed only recently, and they are not yet on the commercial market. All of the others are already familiar items of the insecticide industry, and each now serves useful purposes in the control of certain insects. A study of the table will indicate that some killing of bees may be expected when any of these insecticides is applied to alfalfa that is in flower. Furthermore, all but two of the insecticides tested appear to be too destructive to bees for use on plants in bloom. The two exceptions are methoxychlor and

(Continued on page 18)

H. E. Dorst, federal collaborator in entomology and Prof. Bliss H. Crandall, director of the laboratory, discuss an experimental design for testing a large number of promising methods for control of insects on crop plants (right)



Key punch operators, Ulva Robinson, Winifred Smith, Helen Griffiths, and Lois Dewey, transcribe data from field records to punched cards

D. A. Broadbent, assistant director, assists with analysis of livestock auction study in the western states

Statistics in Agricultural Research

Statistics is a word with many meanings and to most people it is something quite different from the work of the statistical laboratory of the Agricultural Experiment Station. The pictures on this page show some of the activities of this unit that deal with the design of experiments, tabulation of the results, and assessing their reliability. (see page 4 for additional material)

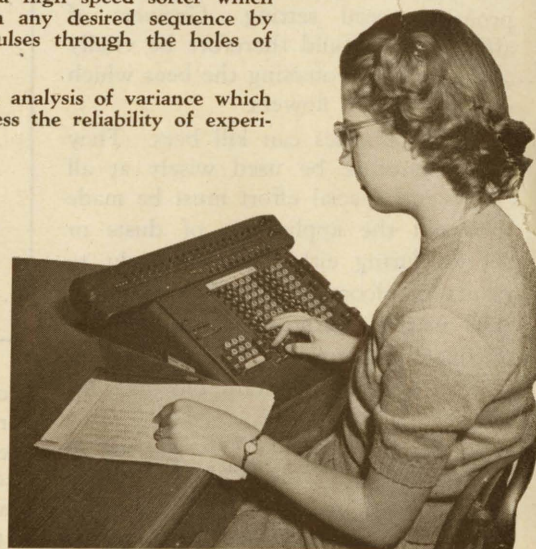
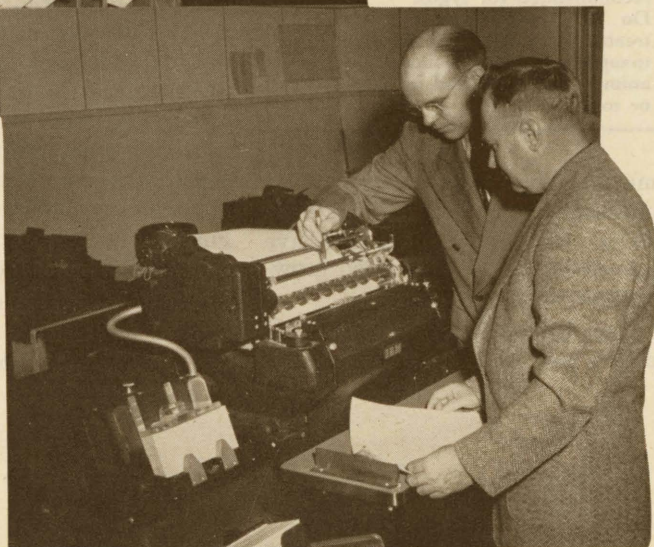


Miss Robinson operating a high speed sorter which arranges unit records in any desired sequence by means of electrical impulses through the holes of punched cards (left)

Mrs. Dewey completing an analysis of variance which makes it possible to assess the reliability of experimental results (right)



Dr. T. D. Bell professor of animal husbandry, stationed at the B.A.C. and Prof. Crandall discuss the tabulation of data resulting from several years' effort in developing sheep better adapted to Utah ranges



Farm and Home Science



Fig. 1 Necrotic ring spot symptoms on sweet cherry leaves. The tattered condition results from the dropping out of necrotic areas. The leaf on the right is normal

RING SPOT CAUSE OF TREE DEGENERATION IN UTAH ORCHARDS

Seriousness of Disease Not Realized Because of Lack of Symptoms
After Initial Stage

By G. W. COCHRAN, B. N. WADLEY, G. H. KALOOSTIAN and B. L. RICHARDS

RING SPOT is the most prevalent stone fruit virus disease in Utah orchards. Much of the degeneration in the trees of Utah's stone fruit orchards is a direct result of the effects of the ring spot virus. The virus infects peaches, sweet cherries, sour cherries, plums, apricots, and wild chokecherries. Its high incidence in nearly all stone fruit orchards results in considerable economic loss to fruit growers because of reduction in yield. The seriousness of these losses is not generally realized since infected trees usually show no symptoms after the initial onset of the disease.

Many ring-spot-infected trees are also infected with other viruses. Ring-spot-infected peach trees are commonly infected with the western x virus; sour cherry trees that have the yellows disease usually are infected with ring spot virus; sweet cherry trees carrying the rusty mottle virus also commonly carry the ring spot virus. When orchard trees

The authors are all working on the problem of virus diseases of stone fruits in Utah. DR. COCHRAN and DR. RICHARDS are associate professor and professor and head of the Department of Botany and Plant Pathology of the Utah Station, respectively. DR. WADLEY is employed by the U. S. Bureau of Plant Industry, Soils, and Agricultural Engineering. MR. KALOOSTIAN is an entomologist with the U. S. Bureau of Entomology and Plant Quarantine.

are infected with more than one virus it is important to recognize the symptoms caused by each virus.

Cause of the Disease

Ring spot disease is caused by one or more related viruses or by many strains of the same virus. These strains may be differentiated by the types of symptoms produced in the various stone fruits. Certain strains produce severe symptoms while others produce mild symptoms. A strain producing severe symptoms in peaches may or may not produce severe symptoms in cherries or in plums.

Symptoms of the Disease

As the name implies, the most common symptoms are the development of small rings or circular spots in the early spring leaves. These vary from faintly chlorotic rings that are scarcely detectable to necrotic rings or spots that eventually drop out of the leaves. Leaves of sweet cherries affected with necrotic symptoms are shown in fig. 1. When the necrotic spots drop out of the infected leaves the condition has been called lace-leaf or tatter-leaf.

Ring spot leaf symptoms usually show only the first year or two following infection; symptoms do not develop in the leaves after all of the tissue of the tree has been infected. Diagnosis of



Fig. 2. Four-year-old Elberta peach tree one year after inoculating with ring spot virus. The inoculated branch on the left was killed during the winter following infection. Bark cankers are developing on the trunk and are extending upward on the other main branches

ring spot is extremely difficult when the progress of the disease has passed the stage of leaf symptom expression for then it becomes almost impossible to detect diseased trees by visual orchard inspection. Since trees in this stage of the disease have normal-appearing foliage they are commonly used by nurserymen and orchardists as budwood sources. When infected buds are placed on virus-free rootstocks, many of the buds abort and fail to make a graft union with the rootstocks. All trees propagated from buds taken from diseased trees carry the virus. It is highly probable that much of the spread of this disease has taken place in this manner. Nursery trees propagated from diseased buds usually never develop the ring-spot-leaf symptoms in the scion growth. However, shoots arising from the rootstocks will develop symptoms if the rootstocks were originally free of the virus.

Ring spot virus is commonly transmitted from infected mazzard and mahaleb trees through their seed to seed-

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More detailed information on the subjects discussed here can often be found in Station bulletins and circulars or may be had through correspondence.

(College series No. 809)

STATISTICS IN AGRICULTURAL RESEARCH

By BLISS H. CRANDALL

DOING research is like building a house in that both require carefully laid plans if the project is to be successful. One of the important functions of the statistical laboratory is to assist project leaders in designing efficient experiments that will obtain the information desired with a minimum of time and expense. When dealing with farm problems, years of research are often required before the answers to important questions can be obtained. If the experiment is too small the farmers of the state must wait while it is repeated, because the results are not conclusive. If too large, unnecessary time and money will have been expended which could have been better utilized in other related phases of the problem. There are always many more questions to be asked in a research program than can possibly be answered with limited funds and personnel.

In recent years, experimental design has received considerable study by statisticians the world over, and many new plans have been developed which greatly increase the efficiency of research. Since it is impossible for project leaders to keep informed on these developments in addition to advances in their own field, it is necessary that these new designs be adapted to their research through consultation with a trained statistician. Many times an experiment can be successfully completed with a new, more powerful design at a small fraction of the cost required by plans widely used in the past

After the experiment is designed, the plans must be carefully followed, and often modified, as field conditions demand. Reliable methods of measuring the results must be devised and the measurements made and tabulated during the course of the experiment. In many large experiments, which often require several years for completion, volumes of measurements are recorded that must be analyzed before the results can be translated into specific recommendations to the farmers of the state. In the past the tabulation and analysis of these data have required several years after completion of the experiment and much information of a supplementary nature has been lost because of the time and money required to get it out of the mass of figures.

Recently an installation of International Business Machines was made in the Statistical Laboratory. These machines make it possible to summarize the arithmetic resulting from experiments accurately and in a much shorter time than required by hand operated calculating machines used in the past. Pictures of some of these machines are shown on page 2. The field data are recorded by punching holes in specific locations on a rectangular card. These cards are fed through the machines automatically at a rapid rate and the usual arithmetic operations completed by means of electrical impulses through the punched holes.

Since in biological experiments re-

sults vary from trial to trial, the real effects of the treatments are always somewhat questionable. For example, if two fields of alfalfa are involved in an experiment, one receiving 125 pounds of treble-superphosphate per acre and the other none, and the treated field produces one half ton per acre more hay than the untreated field, one cannot be sure the increased yield is the result of the phosphorus since the treated field may have been more productive regardless of whether phosphorus was applied or not.

To remove the possibility of this effect leading to false conclusion, it is necessary to repeat the experiment on a number of paired fields with a wide variety of conditions under which one wishes to make a recommendation regarding the possible benefits of phosphorus fertilization. When the results of such a well designed experiment are tabulated, they must be analyzed by accurate methods based upon the mathematics of probability before reliable recommendations can be passed on to farmers about the questions under investigation.

The functions of the Statistical Laboratory are to assist project leaders with the design of experiments, in the tabulation of the results, and in determining the reliability of the experimental data. These are important steps in translating ideas into profitable recommendations which the farmers of Utah can follow with confidence.

CONTRIBUTIONS TO RESEARCH

1 case R.O.P. hatching eggs
1 case R.O.P. hatching eggs
Pen of 26 chickens that won Income
over Feed Cost contest
Pen of 26 Barred Rock chickens
\$500 for turkey breeding studies
1200 pounds of whey for swine feeding tests
100 tubes 7.5 milligrams aureomycin
for research on treatment of
mastitis
Streptomycin for research on sinusitis
in turkeys and respiratory diseases
of chickens
10 pounds Thiametroimidine powder
for prevention of blackhead in turkeys
3000 kow towels for use in research
in mastitis

Ramshaw Hatchery, Salt Lake City
Ghostley Poultry Farm, Anoka, Minn.
Babcock Poultry Farms, Ithaca, N.Y.
Babcock Poultry Farms, Ithaca, N.Y.
Daws Manufacturing Company
Cache Valley Dairy Association

Lederle Laboratories

Dixon and Company

Bonneville — A New Spring Barley Ready For Release

By R. W. WOODWARD

BONNEVILLE, a new variety of spring barley (C. I. 7248), with stiff straw, clubs heads, and smooth awns will be released this spring for registered seed production in both Oregon and Utah. This variety has out-yielded Velvon by about 20 percent in a series of tests conducted in the western United States and Canada. It has produced the highest yields of any barley ever tested in Utah. It is especially adapted to fertile irrigated lands in sections where the season is fairly long, and should not be recommended for submarginal land or where low yields are the rule. It is four to six days later than Trebi or Velvon and for

DR. WOODWARD is agronomist with the U. S. Bureau of Plant Industry, Soils, and Agricultural Engineering and works cooperatively with the Utah Station in cereal breeding.

this reason may not be adapted to dry lands or to high elevations where short seasons prevail. It should do well on the better irrigated lands of Cache, Box Elder, Weber, Salt Lake, Utah, Sevier, and Iron Counties.

Although new varieties appear every few years, the layman seldom is aware of the amount of work that goes into the development of every new variety. Bonneville has been undergoing selection and testing for about 15 years. One of its parents, Colorado 3063, was produced by Dr. D. W. Robertson of Colorado before 1929. He used as its parents Coast, formerly a popular rough-awned 6-rowed barley, and Lion, a black smooth awned 6-rowed barley from Russia. Colorado 3063 has smooth awns, some resistance to disease, and rather stiff straw, but it has no particular promise as a variety. The other parent of Bonneville is Winter Club, a tall, late maturing, rough awned, club type of winter barley whose history is unknown. It was first found in Lewiston, Idaho, in 1903. In 1907 it was found also near Nephi, Utah, where farmers claimed it had been grown for 35 years.

Bonneville, a new, stiff strawed, smooth awned, compact club barley

In breeding improved varieties numerous crosses often are made in order to insure ultimate success. In 21 years of barley breeding at the Utah Station more than 600 crosses have been propagated, selected, and tested. Often the best varieties give mediocre progeny, while some of the best strains come out of crosses between two parents that themselves show little promise. Needless to say the credit for new varieties often extends to several plant breeders.

Head selections are made from crosses that appear to be desirable and the seed is then planted in head rows for observation. Those strains among the head rows that have the most desirable characters are saved for more advanced nursery tests. Disease tests are conducted by inoculating each strain artificially with smuts, and observing mildew, scald, or rust infection when these diseases occur naturally. Each new promising strain is sown in a yield nursery when 250 grams of seed is available. Yield, test weight per bushel, and other agronomic data—such as date of heading, height, lodging, and general appearance, are recorded in each 4-row plot in the yield nursery.

When strains such as Bonneville show exceptional promise for three or more years, they are advanced into the Rocky Mountain Barley Nursery. This regional nursery is sown at various locations in all of the western states and in Canada. Data are gathered from all these nurseries for three or more years. These data are summarized annually for the use of all cooperating experiment stations.

Bonneville has passed through all the steps outlined. Its yields have been high in most places where it has been grown. At Logan it yielded 25 percent more than Velvon. In 1948 its yields were from 8 to 35 bushels an acre

(Continued on page 8)



Spacing of Sugar Beets Studied in Relation to Yield and Quality

24,000 to 26,000 Beets per Acre or Planting 12 inches Apart in the Row
and 20 inches Between Rows Found to Give Best Results

By JAY L. HADDOCK

RESEARCH at the Utah Station has shown that it is much safer for the grower of sugar beets to err in planting too many beets per acre rather than too few. Beets may not be as large, but the farmer's returns will be as large or larger because of higher yields and bet-

ter quality. A spacing of about 12 inches in the row and 20 inches between rows or plant populations between 24,000 and 26,000 beets, seems to give the best yields.

In the early development of sugar beet growing close between-row and with-in-row spacings were the rule. As more and more horse-drawn and motor-driven machines were used in cultivating and harvesting the crop, it became necessary to increase the between-row spacing. This trend for wider between-row spacing has been dominated in some areas by adaptability of current

machinery for use on the sugar beet crop. The standard between-row spacing in the Midwest and Great Lakes area is 28 inches. In order to mechanize sugar beet production more completely in California, the between-row spacing of 30 inches is general. There is a growing tendency in the intermountain area to increase the distance between rows as well as to increase the interval in the rows of sugar beets. As harvesting equipment becomes more general it is expected that this tendency will increase.

Previous research has given good reason for holding pretty close to a with-in-row spacing of about 12 inches and a between-row spacing of 20 inches in the Intermountain area. However new developments in experimental design and soil moisture recording instruments have emphasized the advisability of re-examining this subject.

It has long been recognized that the more space a sugar beet plant has, the larger the size of the root, but the increase in root size is proportional to the space allotment. It has also been ob-

The research reported in this article is a phase of the western regional study on the irrigation, fertilization, and soil management of crops in rotation, which is being conducted at the Utah Station. Cooperating agencies include the Bureau of Plant Industry, Soils, and Agricultural Engineering; the Division of Soil Management and Irrigation of the Soil Conservation Service; and financial assistance from the Beet Sugar Development Foundation, the Amalgamated Sugar Company, the Utah-Idaho Sugar Company, and the Aluminum Company of America. DR. HADDOCK is agronomist in the Bureau of Plant Industry and works cooperatively with the Utah Station.

Experimental plots in Garland where tests were conducted on the irrigation, fertilization and soil management practices in production of sugar beets



served that widely spaced beets do not ripen as rapidly as closely spaced plants and hence contain a lower sucrose content.

From 1890 to 1900, there developed a strong movement for narrow spacing of plants. The extreme spacing pattern was 13 inches x 6 inches and 8 inches x 8 inches giving way a decade later to 15 inches x 7 inches. The preferred pattern in many parts of Europe was 18 x 10 inches.

From the beginning of sugar beet culture in the United States the standard spacing has been about 20 x 12 inches or about 240 square inches per plant. The pressure for wider spacing continues. It is obvious that as between-row spacing becomes wider the planting, thinning, top-dressing, cultivating, and harvesting time is decreased. It is therefore only reasonable to expect this tendency for wider spacing to continue until loss of yield or decreased sugar production exceeds the advantages of wider spacing.

Experimental Results at the Utah Station

The general importance of the sugar beet industry to the agriculture of irrigated western United States may lend interest to the observations made at the Utah Experiment Station during the past three years.

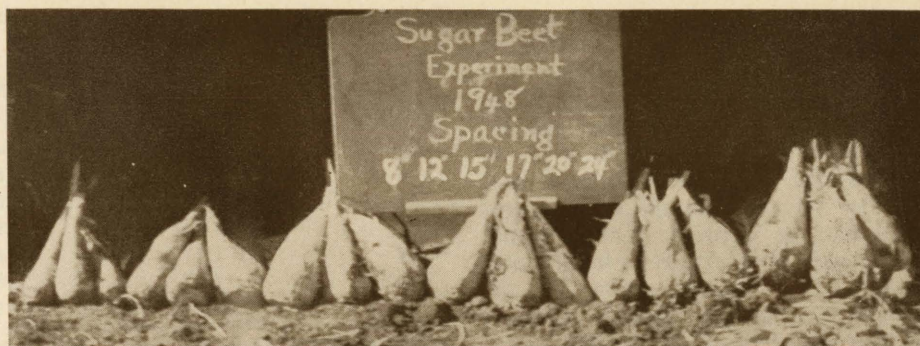
Table 1. Yield of sugar beets as influenced by row-width spacings, Garland, Utah, 1947

Spacing pattern	Plants per acre	Yield per acre
	<i>number</i>	<i>tons</i>
12"—20" x 6"	65,340	25.84
12"—20" x 12"	32,670	25.81
20" x 12"	26,135	26.63
22" x 12"	23,760	26.19
24" x 12"	21,780	24.17

Table 2. Yield and quality of sugar beets as influenced by between-row spacings, Garland, Utah, 1948*

Relative irrigation & fertilizer treatments	Yield per acre		Sucrose		Purity	
	20" row	22" row	20" row	22" row	20" row	22" row
	<i>tons</i>	<i>tons</i>	<i>percent</i>	<i>percent</i>	<i>percent</i>	<i>percent</i>
No fertilization						
inadequate irrigation	9.81	10.38	14.11	13.66	91.33	89.47
Mean of six irrigation & six fertilizer treatments	13.29	13.29	15.32	15.21	90.33	89.84
Mean of six irrigation regimes, adequate fertilizer treatments	15.84	15.62	14.03	13.92	87.73	86.67
Adequate fertilization adequate irrigation	17.28	16.90	13.00	13.38	88.53	86.57

*Within-row interval was 12 inches throughout.



With close spacing beets are not as large, but there are more of them and the quality is better

Plant Population and Yield

It was observed in 1946 that significant increases in yield with use of barnyard manure and commercial fertilizer were obtained only with high plant populations (33,000 plants per acre). This study included varying plant populations from 22,000 plants per acre (24 inches between rows, 12-inch interval in the row) to 33,000 plants per acre (alternating 12 and 20 inches between rows, 12-inch interval in the row). Yield differences among variously nitrogen-fertilized plots were greatest where plant population was high and soil moisture was kept at a high level.

No significant differences in yield were observed in 1947 between plots having 26,000 plants per acre and those having 52,000 plants when spacings between rows were constant (20 inches) and row intervals were varied, from 6 inches to 12 inches. However, when distances between rows were varied and the interval in the row held constant there was indication that a 24 inch row may be too wide for highest yields. A fair pictures of what might be expected where soil moisture conditions and fertility level are adequate and plant populations are varied by between-row spacings is shown by the data in table 1.

In 1948, a detailed study was made of two row-width spacings (20 inch and 22 inch) in which the spacing interval in the row was held constant at 12 inches. The results of this study are found in table 2. It will be observed that the differences are small and none of them are significant.

A within-the-row spacing study conducted in 1948 on rows spaced 22 inches apart in which soil moisture and soil fertility conditions were adequate gave the rather surprising results shown in table 3.

It may be well to note, that on this particular test yields are not significantly different on 22-inch row spacing as the actual interval varies from 10 to 22 inches.

Plant Population, Sucrose, and Purity Percentage

It is reasonable to expect that, should a farmer double the number of sugar beet plants growing on a given soil area with a limited supply of available nitrogen, competition among plant for this nitrogen occurs. Likewise, it is reasonable to assume that, if a farmer were growing 33,000 sugar beets on an acre of land that could not supply sufficient nitrogen for the best growth of these plants, competition would be lessened if he should remove 10,000 plants leaving only 22,000 plants per acre.

It has been well established that excess available soil nitrogen tends to stimulate vegetative growth of sugar beets and hence tends to lower both the sucrose percentage in the root and the percentage purity of the expressed juice from the beet.

Data have been accumulated which show clearly the delicate balance that exists among the three factors, available nitrogen, plant population, and sugar beet quality. When sugar beets are grown on a soil of a given nitrogen-

supplying power, the percent purity and percent sugar increase as the plant population increases. This tendency appears to become stronger as the nitrogen-supplying power of the soil increases. These facts would seem to suggest that when soil fertility is low, a wider than normal spacing of sugar beets may be justified. On the other hand, when soil fertility is high, closer than normal spacing may be desirable for the best growth of sugar beets, particularly if soil moisture is not limiting.

It has been stated previously that the data in table 2 do not indicate a significant difference in yield between 20-inch and 22-inch rows. The data on sucrose percentage likewise, show no significant difference. However, there appears to be a tendency for slightly lower sucrose percentage in the beets grown with wider spacing. The differences in percent purity are significant. These facts strengthen the conclusion reached previously that the smaller the plant population the greater the tendency for lower sucrose and purity.

The data in table 3 further strengthen the conclusion that the lower the plant population the stronger the tendency for lower sucrose and purity percentages. The data for the 20-inch interval appears to argue against this tendency, both for sucrose and purity. There are actually no significant differences in sucrose percentage. The purity data of 8, 12, and 15-inch intervals are however, significantly higher than for the 17 and 24-inch intervals.

Plant Population and Nitrate-Nitrogen Composition of Leaf Petioles

Some interesting data has been obtained that support the belief that an inverse relation exists between available soil nitrogen and quality of sugar beets. Data is also available that show that as plant population increases the concentration of nitrate-nitrogen entering the plant along the leaf petioles decreases. The nitrate-nitrogen content of the plant apparently determines the emphasis which a plant gives at the moment to carbohydrate storage in the root on the one hand and leaf growth on the other.

What Can the Farmer Do

One of the first questions which occurs to a man growing sugar beets is: What is one to conclude from this research data relative to the actual spac-

Table 3. Yield and quality of sugar beets as influenced by within-row spacing, Garland, Utah, 1948*

Within-row interval		Yield per acre	Quality of sugar beets	
Attempted	Achieved		Sucrose	Purity
<i>inches</i>	<i>inches</i>	<i>tons</i>	<i>percent</i>	<i>percent</i>
8	9.7	18.7	16.49	90.66
12	12.9	20.4	16.37	90.17
15	14.4	19.7	16.14	90.82
17	15.1	18.8	15.87	88.67
20	19.3	18.6	16.60	89.65
24	22.4	19.1	15.44	88.44

*All rows spaced 22 inches apart. Mean of seven replications.

ing of sugar beets in a commercial field?

It appears obvious from the data given in this report and from other accumulated data that considerable variation in plant population may be tolerated without affecting the total yield provided soil moisture and available soil nitrogen do not become excessive or limiting—and providing further that plant spacing is uniform throughout.

While it is possible to accomplish all these conditions on experimental plots there are some obvious difficulties in achieving them in commercial sugar beet fields. First of all it is not easy to judge or control the nitrogen-supplying power of the soil just to fit the sugar beet crop. Many factors influence this, such as past cropping and fertilizer practice, natural climatic conditions, and soil texture. If too little nitrogen is available for the plant population, best growth will not be obtained, if too much nitrogen is available the quality may be poor. Second, it is not an easy matter to maintain adequate soil moisture conditions because generally irrigation is determined by a set period of days and by the competition of other crops for water. Third, it is seldom that plant spacing is sufficiently

uniform to obtain maximum yields at any particular spacing. The wider the spacing or the lower the plant population the more difficult this problem becomes.

In view of the above analysis of the sugar beet spacing problem what insurance can a farmer take to obtain the best results from field spacing? It is much safer to use close than wide spacing. When plant population is high, yield and quality are not sacrificed. The results of numerous field trials have tended to support a commercial field spacing of about 12-inch interval in the row and 20-inch spacing between rows. Observations at this Station indicate that it may be reasonably safe to go as far as a 22-inch spacing between rows and a 15-inch interval in the row without incurring decreased yields, providing uniform stands can be obtained. It would appear the part of wisdom not to stray too far from a 20 inch x 12 inch, 20 inch x 15 inch, or a 22 inch x 12 inch spacing pattern. A reasonable number of skips can be tolerated under spacing patterns of this kind without seriously affecting yield or quality. If plant populations fall much below this, both yield and quality may suffer.

BONNEVILLE BARLEY

(Continued from page 5)

higher than Velvon at Lethbridge, Canada; Fort Collins, Colorado; Aberdeen, Idaho; Bozeman, Montana; Ontario, Oregon; Prosser, Washington; Laramie, Wyoming; and Logan.

The cooperative breeding tests have aided materially in evaluating improved varieties of cereals. In these regional tests new strains not only are subjected to many environmental situations, and diseases, but their range of adaption can be established. Some strains have only

localized adaption while others perform well over large areas.

Bonneville will be distributed to reliable certified seed growers, and, if properly cared for, registered seed will be produced in 1950 for general distribution. If the new variety shows serious defects that were unnoticed heretofore, each grower will sell the seed back to the Crop Improvement Association according to his contract, and the grain will not be sown.

SOIL testing is rapidly finding a place in modern agriculture. For years scientists sought means of predicting fertilizer needs from chemical tests made on the soil. It was not until quite recently, however, that much progress was made. Even after satisfactory chemical methods were devised, it was necessary to correlate test values with crop responses to fertilizers on a large number of different soils.

About five years ago a soil testing laboratory was established at the Utah State Agricultural College in cooperation with the Soil Conservation Service. During this time much information has accumulated on Utah soils, so that the crop response that can be obtained from

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WHY NOT USE A SOIL TEST AS A GUIDE TO YOUR FERTILIZER PRACTICE

By J. P. THORNE and D. W. THORNE

an application of phosphate or other fertilizer can be predicted in a large percentage of the cases.

Research done at the College, at the Regional Salinity Laboratory at Riverside, California, and elsewhere has provided a background of information that makes soil tests on salty and alkali soils useful. For example, a determination of the amount of exchangeable sodium provides a good index to the amount of sulfur or gypsum needed for reclamation of "slick spots." Measurements of electrical conductance of samples from saline soils can reveal their potentialities for growing various crops.

The Soil Testing Laboratory is set up specifically for testing samples of soil and irrigation water for the benefit of Utah farmers. In 1949 about 3000 samples of soil and water were analyzed in the laboratory. As more use is made of commercial fertilizers more demand for soil tests is created. Perhaps this service can best be described by answering some of the questions that are so often asked regarding soil testing.

What Is A Soil Test?

A soil test is a chemical analysis of a sample of soil. It is a measure of some particular plant nutrient in the soil or a measure of a soil characteristic such as salinity, alkalinity, or acidity. In general rather rapid analytical proced-

ures are used. They may be performed in the field or in the laboratory, but in the laboratory the facilities are more adequate and such things as soil moisture, temperature, amount of soil used, and quality of reagents used can be controlled better.

What Value Can A Soil Test Have In Farm Practice?

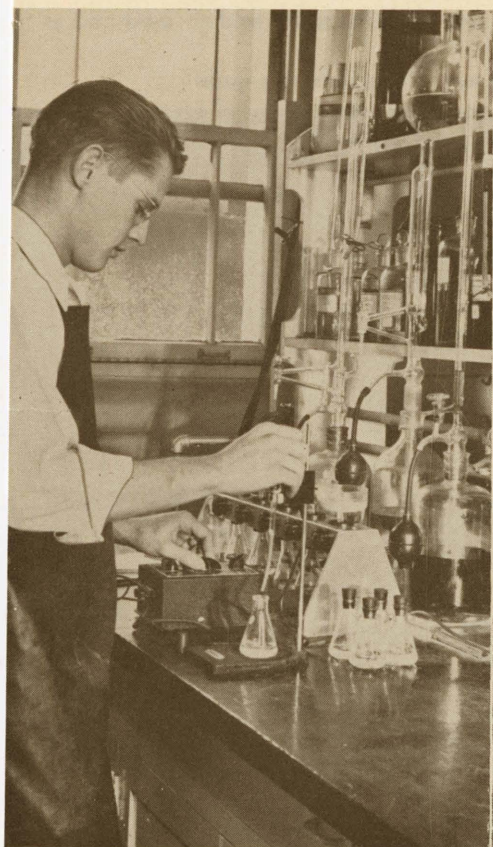
A soil test can furnish definite information about any piece of ground. For example, suppose you have grown sugar beets for many years and have applied phosphate fertilizer. Do you know whether or not all this phosphate was needed? A soil test can give you this information.

On another part of your farm you may have noticed some "slick spots" developing—places where the soil does not absorb water well and the plow tends to jump out of the soil when you are plowing. A soil test can tell you whether this condition is caused by sodium accumulation, and if so, how much sulfur or gypsum will be required to restore these spots to productivity.

You may suspect that the lower part of one of your fields contains too much salt for some crops. Here again a soil test can give you the answer.

There are, of course, many soil problems that at present cannot be answered by soil tests. Nitrogen needs

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(Above) David Miller measures the electrical conductance of soil extracts to determine salt content

(Right) Patricia Wood extracts soil samples with carbon dioxide and then filters them to determine available phosphorus content



Mountain Meadows Respond to Proper Management

Reseeding, Water Control, and Fertilizers Increase Yields and Palatability of Forage

By D. W. PITTMAN and R. F. NIELSON

EXPERIMENTS in typical mountain meadow areas throughout the state show that forage production can be increased in these meadows by plowing and reseeding to high producing palatable grasses and clovers, by maintaining high fertility through the use of fertilizers, and by controlling irrigation water to prevent excessive flooding.

There are thousands of acres of mountain meadows in the state that are used for grazing purposes and where often one crop of hay is cut. In some areas, particularly in Sanpete and Cache Counties, large acreages of these meadow lands are waterlogged and con-

tain high salt concentrations in the topsoil. This salt problem becomes acute late in the season and often causes considerable trouble. Few if any of the high producing forage plants are adapted to conditions where excessive water and salt are found. Plants that can stand the excess water will not live in the high salt concentrations that are often found in midsummer. The reverse is true in that plants having a high salt tolerance often do not survive the excess moisture conditions present in the spring.

In other parts of the state because of high elevation and short growing season, land that would otherwise be used for production of farm crops is used for the production of meadow hay.

The species of plants making up

these mountain meadows are quite variable. Where the meadows are covered with water for long periods of time in the spring and early summer, the principal plants found are sedges and wiregrass. If the flooding occurs only for short periods in the spring, timothy, redtop, and meadow fescue often become established naturally. In some cases white dutch clover makes up a part of the meadow mixture, however, most of the native meadows consist almost entirely of grasses with few clovers present.

Irrigation practices on these pastures usually consist of continuous flooding early in the spring, with intermittent irrigations applied throughout the summer. Fertilizers are seldom used and as

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Mountain meadow near Alton, Kane County, typical of the ones where the fertilizer and seeding tests were made





The plot at the right was only a few feet from the one on the left. The difference, phosphate fertilizer was applied to the plot on the right and nitrogen to the one on the left. Nitrogen stimulates the growth of grass, phosphate, the growth of clover

a result the soil fertility level is usually low.

Experiment in Rich County

Investigations were started by the Utah Agricultural Experiment Station in 1945 to develop methods and practices whereby forage production from these mountain meadows might be increased. Experiments were established in Rich County and the data collected over a four year period. Results are shown in table 1.

It may be noted from this table that threefold increases in yield were measured when the sod was plowed and a seedbed prepared before reseeding. Reseeding in the native sod increased production, but the increase was much less than when a seedbed was prepared.

Of the species used in another series of tests in Rich County, strawberry

clover looks the most promising for wet saline meadows. It has withstood considerable submergence and has not been damaged by moderate salt concentrations if kept wet; however, it will not stand long periods of seasonal drought. Of the grasses tested, reed canary grass is the most water tolerant; but it is difficult to establish and does only moderately well on a saline soil. Results from these studies at Rich show that reseeding to high producing grasses and clovers is the first step towards meadow improvement.

Fertilizers Found to Increase Yields of Meadow Hay

A series of fertilizer experiments was established in 1949 at various locations throughout the state in order to study the effects of commercial fertilizer on meadows harvested for hay. The tests

were made in Kane, Piute, Garfield, and Duchesne Counties. Each of these counties has large acreages of land in meadow hay. Forage production on most of the meadows studied is comparatively low. Lack of adequate soil fertility was believed to be the principal factor contributing to this low production.

Fertilizer treatments used in the experiments consisted of nitrogen, phosphate, and potassium at various rates and in various combinations. Application was made by broadcasting the material on the sod in the spring before any new growth had appeared.

Yield data were collected at the time of harvest by cutting a strip out of each fertilized plot. The hay from each plot was then weighed and yields calculated on an acre basis (table 2).

The results of these experiments carried out in 1949 indicate that a response in yield to the application of fertilizer may not be expected on all types of meadows. Variation in yield data on the meadows listed in table 2 resulted largely from the difference in the length of the spring grazing period and do not represent the total production for the entire season.

Large applications of commercial fertilizer, either nitrogen or phosphorus, caused only minor increases in yield when the majority of the plants in the meadows were sedges and wiregrass. On native meadows where timothy, reedtop, and meadow fescue had established themselves, the yield was increased as much as one ton per acre with the application of 200 pounds of ammonium sulfate. Meadows that had been reseeded to higher producing

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Table 1. The effect of plowing, reseeding, and fertilizer on the yield of meadow hay. (Yields in tons per acre)

Treatments	1945	1946	1947	1948
	tons	tons	tons	tons
Treatments applied without plowing				
No treatment .....	.76	1.17	1.26	1.10
Manure	1.35	1.88	2.00	1.63
Manure and phosphate.....	1.30	1.89	1.81	1.52
Nitrogen and phosphate	1.54	1.29	1.34	1.34
Alsike and red clover seeded .....	.84	1.70	2.06	1.23
Alsike and red clover seeded plus phosphate .....	.91	2.50	1.98	1.32
Alsike seeded, plus phosphate and manure	1.26	2.80	2.60	1.69
Treatment applied after plowing				
Timothy and red clover seeded		3.07	2.25	1.66
Timothy and red clover seeded plus manure and phosphate		4.32	3.16	2.29
Brome, fescue, and alsike seeded		3.32	2.01	1.25
Brome, fescue, and alsike seeded, plus manure and phosphate		4.92	3.21	1.87



Fig. 1 Representative alfalfa plant from an untreated control area on left and an area fertilized with 400 pounds of treble superphosphate and 100 pounds of copper sulfate on right

FERTILIZERS greatly increased both yield and mineral content of alfalfa in tests conducted by the Utah Agricultural Experiment Station in various parts of the state. About one-third of Utah's cropland and 38 percent of its irrigated land are planted to alfalfa. The state's livestock economy is limited by the amount of forage that can be produced. A 50 percent increase in alfalfa production could materially increase the numbers of livestock that could be fed. But probably more important than the increase in quantity

This study is a part of a more comprehensive project dealing with the interrelationships between the composition of the soil and plants and the nutrition of animals and man, cooperative with the Departments of Agronomy, Animal Husbandry, Dairy Husbandry, Poultry Husbandry, Chemistry, Foods and Nutrition, Range Management, and Veterinary Science. DR. D. A. GREENWOOD is professor of biological chemistry and in charge of the project. D. W. PITTMAN is professor of soils. The chemical analyses were made by Dr. M. C. Cannon, Ferrin Mangelson, Carol Watkins, and Robert Weiman. The treble superphosphate used in the fertilizer tests was furnished by the Anaconda Copper Company. The project is also receiving financial aid from the International Minerals and Chemical Corporation and the Kennecott Copper Company.

FERTILIZERS AFFECT COMPOSITION AS WELL AS YIELDS OF ALFALFA

By D. A. GREENWOOD and D. W. PITTMAN

of forage in these tests is the increase in quality. Fertilizers increased the phosphorus, cobalt, and copper content. Feeding tests to determine the nutritive value of the fertilized alfalfa now under way must be continued before definite conclusions can be drawn, but studies begun a year ago indicate differences in rate of growth and mortality of rabbits fed the different hays.

Fertilizers Studies

These fertilizer studies are being made on farms of collaborators in Cache, Duchesne, Emery, San Juan, Uintah, and Utah Counties. Before the alfalfa was planted soil samples from each of the farms were analyzed for calcium carbonate, available phosphorus, available potassium, total soluble salts, organic matter, and pH. Most of the soils tested low in available phosphorus and had a pH of about 8.

The land on each farm was divided into plots and treated with different types and amounts of fertilizers as shown in tables 1 and 2, and planted with certified Ranger alfalfa seed during the spring of 1947 or 1948.

After the hay was harvested samples were taken for chemical analysis and for feeding tests with small animals. The average yields of alfalfa hay on the plots treated with the different fertilizers on an unirrigated farm in Cache County and the estimated gross cash value of the hay are summarized in

table 1 and illustrated in figure 1. The highest yield was obtained on plots treated with 400 pounds per acre of treble superphosphate plus the trace elements. The next highest yield was harvested on plots treated with the same amount of treble superphosphate plus copper sulfate.

The average yields of Ranger alfalfa hay on an irrigated farm in Emery County are given in table 2. The highest yield was obtained on plots treated with 516 pounds of treble superphosphate and 12 to 15 tons of chicken manure. The next highest yield was on plots treated with the same amount of treble superphosphate plus the trace elements. Lowest yield came from the unfertilized plots.

These studies will be continued for several years to determine the length of time increased yields can be obtained from the fertilizer treatments which were made only before the alfalfa was planted.

Increased Copper and Cobalt Content

The average protein, phosphorus, cobalt, and copper content of the hay grown in Emery County is given in table 3. Of special interest is the increase in cobalt and copper content of the hay produced on the fertilized plots. Cobalt, phosphorus, nitrogen, carbon, hydrogen, and oxygen have been reported to be present in vitamin B₁₂.

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Table 1. Yield of Ranger alfalfa produced on plots treated with different fertilizers on unirrigated farms in west Cache County, Utah, 1949 (1st and 2nd crops)

Treatments per acre, broadcast in spring 1948	Yield per acre (air dry basis)	Est. gross cash value‡	Estimated increase in value above control
	tons	dollars	dollars
200 lbs. t.s.p.*	2.12	33.92	13.28
400 lbs. t.s.p.	2.21	35.36	14.72
400 lbs. t.s.p. plus 100 lbs. CuSO ₄	2.66	42.56	21.92
100 lbs. CuSO ₄	1.85	29.60	8.96
400 lbs. t.s.p. plus 8-10 tons cattle manure	2.40	38.40	17.76
8-10 tons cattle manure	1.99	31.84	11.20
400 lbs. t.s.p. plus trace elements†	3.63	58.08	37.44
Control, no fertilizer added	1.29	20.64	

* t.s.p. = treble superphosphate, available P₂O₅, 42%; CaO, 21.75%.

† Borax 50 lbs., cobaltous chloride 35 lbs., manganese sulfate 100 lbs., zinc sulfate 35 lbs. per acre.

‡ Loose alfalfa hay valued at \$16 per ton.

INCREASING RETURNS FROM WOOL

By MILTON A. MADSEN

To increase returns from wool the sheep producer should:

Increase the wool producing capacity of his sheep through a consistent selection and culling program. Select ewes of above average size, with long staple, and dense wool.

Carefully prepare his shorn wools to improve their marketability.

Use standard wool bags and paper twine.

Stress care in the tying of fleeces. Always shear black sheep last and sack black wool separately.

Keep the shearing floor clean of heavy tags, dirt, and other impurities.

Mark wool bags with distinct but neat brands.

Protect wool from weathering by storing in cool sheds.

Learn the market grades of wools. Keep up to date on market prices.

Whenever possible obtain shrinkage tests. On large lots use the core test, with small lots of farm wool use the composite sample or side samples.

termine methods of improving the wool productivity and quality from individual sheep. Wyoming Experiment Station workers report increasing the average fleece weight of one large herd from 8 to 11 pounds during a period of 10 years through a consistent sheep culling program. The basis for culling in this program was: (1) body weight and conformation, (2) length of wool, and (3) density of wool. Burns in another Wyoming study indicates that an increase of about one-half pound clean wool or one pound of grease wool can be obtained by culling yearling ewes in some of the better flocks in Wyoming. Texas workers found that there is great opportunity for increasing the average weight of fleeces produces by range sheep by culling out the low producers after their first shearing. Culling programs are more effective on mixed flocks than they are on uniform flocks.

Research workers at the U. S. Western Sheep Breeding Station at Dubois, Idaho, found a high relationship between body weight and grease fleece weight and also body weight and scoured weight. The Dubois workers also found that with each three-eighths inch or more increase in staple length there was an increase of approximately three-quarter pounds of grease wool and one-half pound of clean scoured wool. They found that ewes free from heavy face covering or wool blindness yielded slightly heavier fleeces both unscoured and scoured. They also found that freedom from folds was correlated with greater length of staple and greater uniformity of wool throughout the fleece.

Australian research workers found that to get maximum wool production, large yearling ewes with long wool should be selected and the grade of wool should be chosen to fit type of country.

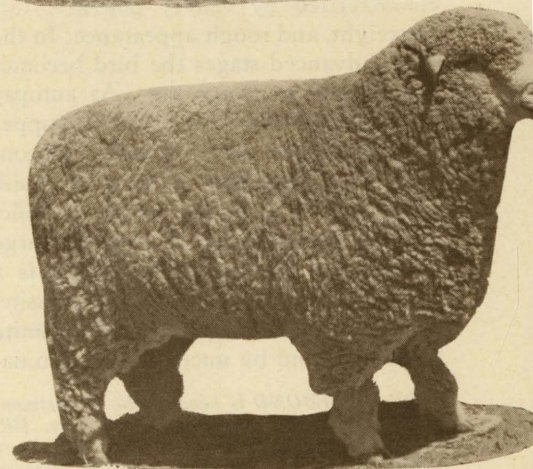
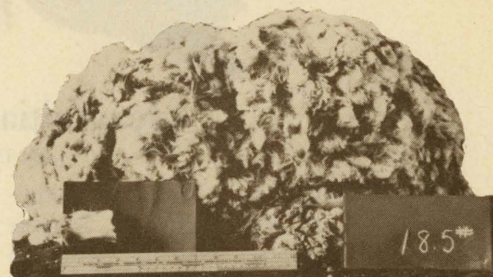
These studies demonstrate that if wool producers adopt a program of careful selection and culling based on the above named characteristics, a marked improvement in the quantity and quality of wool produced per sheep can be obtained.

Preparation of Wool at Shearing

Marketing agencies stress the importance of preparation of wool at shearing time. Instructions to appraisors in the schedule for the 1949 Wool Purchase Program state that all prices quoted are for wool properly prepared. Prices are discounted up to five cents per clean pound in appraising ordinary or poorly put up wool, or wool that for any reason entails excessive conversion costs. The discount for wools containing black or gray fleeces is one-third of the grease appraisal value of white wool, with a discount of ten cents per

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To produce sheep that shear large fleeces with long staple, light shrinkage, and high unit value, select large smooth-bodied, open faced, long stapled ewes and breed them to heavy shearing, long stapled, smooth bodied rams



RISING costs of sheep operations require that sheep men increase their efficiency if they are to show a profit from the sheep enterprise. An effort must be made to increase the receipts per ewe. Receipts from the sheep operation are derived mainly from the sale of lambs and wool with approximately 70 percent of the returns coming from lambs and 30 percent from wool. Operators must strive for increased production of both lambs and wool if they expect maximum returns. Too often there is a tendency to neglect the wool production phase of the enterprise. It is possible to increase returns from wool without any marked increase of expenses. This article discusses some of the ways of increasing these returns.

The marketability of wools may be improved in two ways: (1) by improvement in the quantity, quality, and uniformity of wool produced from the individual sheep, and (2) by the proper preparation of wool during shearing and after it has been shorn.

Sheep Culling Improves Wool Production

Considerable research work has been conducted in the western states to de-

MILTON A. MADSEN is assistant professor of animal husbandry and a specialist in wool.



Turkeys infected with hexamitiasis showing rough condition and tendency of wings to sag

Hexamitiasis Found in Turkey Flocks in Utah

By DATUS M. HAMMOND and MERTHYR L. MINER

DURING the 1949 season a majority of turkey flocks in Sanpete and Juab Counties were infected with hexamitiasis, with average losses of 100 to 200 birds per flock, but with much heavier losses in some cases.

Symptoms of the Disease

Hexamitiasis, or "bowel trouble" as it sometimes is called, is a disease caused by a one-celled animal with the scientific name *Hexamita meleagridis*. The disease has occurred in Utah previously, but has not been detected during the past few years. The disease involves an infection of the digestive tract, and is characterized by watery diarrhea, loss of weight, and rough appearance. In the more advanced stages the bird becomes listless and its wings sag. At autopsy the small intestine, especially the upper part, is swollen and inflamed and contains a considerable amount of fluid. When this is examined under the microscope it is found to contain large numbers of *Hexamita*. *Hexamita* is a relatively small, rapidly moving parasite, with 8 whip-like flagella. The *Hexamita* must be found by microscopic examina-

tion in order to make a positive diagnosis.

The disease usually occurs in poults 1 to 12 weeks in age. The method of initial infection of flocks is incompletely known. Dr. Ethel McNeil, junior animal pathologist at the University of California Experiment Station, has found that young pheasants and quail are susceptible to infection, and thus might become carriers of the disease. Once the disease is started in a flock it is spread rapidly from one bird to others by the ingestion of material contaminated with feces containing *Hexamita*. According to Dr. McNeil the incubation time is four to six days. In addition to death losses, the flock is retarded in growth as a result of the disease.

Losses From the Disease

A survey made in the Moroni area for the 1949 season by Ralph S. Blackham, manager of the Moroni Feed Company, showed that of 26 flocks, 11 or 12 showed enteritis (intestinal inflammation indicated by diarrhea) between the ages of 5 and 15 weeks, and 9 between 18 and 28 weeks. The losses in the first group ranged from 25 to 1000 per flock, with an average loss of 282; in the second group losses ranged from 0 to 350 and averaged 114. The

enteritis occurring in the earlier age group was no doubt caused by hexamitiasis, but that in the later age group was probably the result of other causes.

Beginning about the last week in June, symptoms of hexamitiasis were noticed in several flocks in Juab and Sanpete Counties. The authors investigated several of these flocks and found *Hexamita* in nearly all of the sick birds examined. The epizootic appeared to diminish after the middle of August. Information concerning incidence of hexamitiasis is not available for other parts of Utah. There were a number of flocks with hexamitiasis in southern Idaho, but these outbreaks occurred at a somewhat later date than those in Utah.

Two flocks first showed the infection at 1 to 2 weeks of age. The remainder were 7 to 12 weeks when the first symptoms appeared. Diagnosis was confirmed by microscopic examination in all 12 flocks. In the majority of flocks a relatively rapid recovery from the disease occurred within two weeks. However, in one flock losses ranging from three to ten birds a day continued for a month after the first two weeks of infection, during which losses ran from about 10 to 20 birds a day. In another flock there

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was a recurrence of serious losses about two weeks after the peak losses in the first outbreak.

Losses ranged from 4 to 75 percent, with an average of 24 percent. The age of the flock at the time of outbreak was apparently an important factor in determining the severity of losses. In six flocks where birds were 11 to 12 weeks of age at the onset of the disease, the losses were below 10 percent, but in two flocks where the birds were one to two weeks of age the losses were 20 to 30 percent, and in four flocks whose age was between seven and nine weeks, losses were 32, 41, 50, and 75 percent. Other factors, such as the availability of shade and general condition of birds probably influenced the severity of losses. Heaviest loss occurred in a flock eight weeks of age at time of outbreak. In this case there was inadequate shade for the birds, and evidence of poor nutritional condition. The watery diarrhea associated with the acute stage of the disease causes a loss of water from the tissues. Lack of shade or reduction in intake of water at this time increases death loss.

Hexamita Found in Intestines

During the acute stage of the infection **Hexamita** are most numerous in the small intestine. In birds recovering from an attack the organisms disappear first from the upper part of the small intestine. In a bird autopsied a week after the acute stage of infection a few **Hexamita** were found in the middle and lower parts of the small intestine, fairly large numbers in the large intestine, and large numbers in the bursa of Fabricius, which is a small blind sac attached to the cloaca. In another bird autopsied two weeks after an acute infection no **Hexamita** was found in the small intestine, but a few were found in the large intestine and bursa. A considerable portion of the birds recovered from hexamitiasis continue to carry the parasites, chiefly in the colon and bursa of Fabricius. In three flocks examined approximately six weeks after outbreak of hexamitiasis the number of bursa samples found positive was 3 out of 6, 8 out of 9, and 4 out of 4. One way in which poults become infected is by transmission from older birds that carry the infection, such as in a breeding flock.

Treatment

Several types of treatment were used in the different flocks. The most common was a 1 to 2000 solution of copper sulfate substituted for water for two days. In addition, several growers used such flushes as molasses or yeast and in some cases, such additions to the food as whey or buttermilk. Since there were no controls, and the course of the disease varied greatly in intensity in different flocks, it is impossible to reach any conclusions as to whether any of these treatments helped significantly. According to Dr. Ethel McNeil, who has probably done more work on this disease than any other worker, the only treatment proved to be beneficial is the feeding of 3 percent dried whey containing 50 to 70 percent lactose in a 1 to 2000 solution of copper sulfate for five to seven days. Since whey settles out rapidly the mixture should be made up fresh and stirred each hour or two. According to Dr. McNeil most poults will readily take the mixture for at least four days, and it usually results in an increased food consumption and an improvement in assimilation of feed.

Further work must be done on this disease to enable the prevention or effective control of future outbreaks. More accurate information is needed on the importance of wild birds in carrying the infection, and other possible means of transmission, and on methods of treatment.

SHEEP INDUSTRY ON DECLINE

Since 1943 the income from the sheep industry has declined from the largest source of agricultural income in Utah to less than that received for beef, dairy, and poultry. Previous to 1944 the sheep industry was the source of 20 percent of the agricultural income of the state. During the 20's it was twice as large as the beef and dairy industries and four times as large as the poultry industry in the state. During the thirties it was only 50 percent larger than these industries. During the last two years 18 percent of the agricultural income has come from poultry, 18 percent from cattle, 14.5 percent from dairy products, and only 12 percent from sheep.

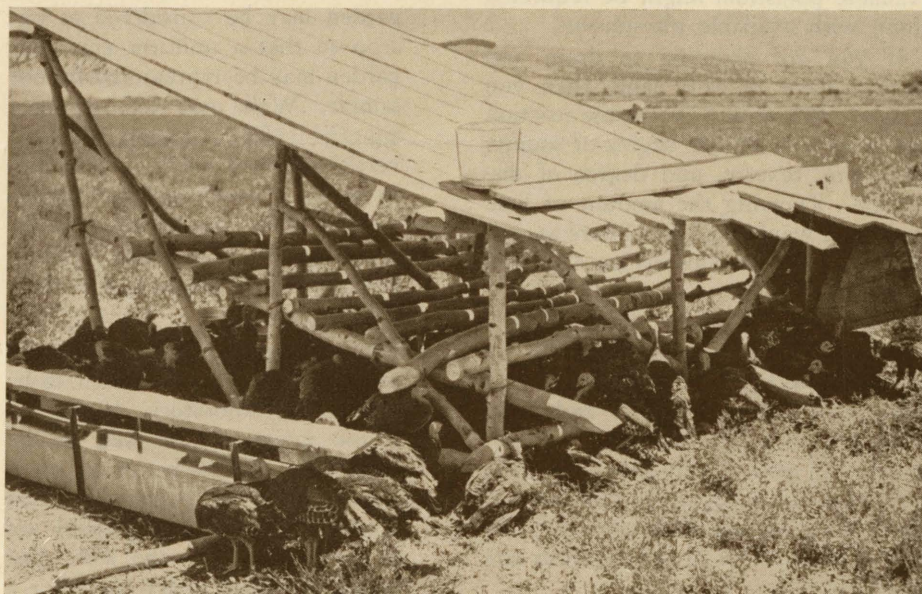
There are 20 million fewer sheep in the nation now than there were 20 years ago and 1 million less in Utah. In 1867 there were 124 sheep per 100 people in the United States. In 1943 there were 40 sheep per 100 people, while in 1949 were only 22 sheep per 100 people. This is the most rapid liquidation of any agricultural enterprise in the history of the country.

—D. A. Broadbent

INDEX

An author and subject index to the first ten volumes of Farm and Home Science has been issued. If you want a copy, write a card to the Utah Agricultural Experiment Station, Logan. There is no charge.

Turkeys sick with hexamitiasis seek shade



SOIL TESTING

(Continued from page 9)

cannot be predicted accurately from test values alone, nor can the need for some of the minor elements such as manganese, iron, zinc. Nevertheless, one experienced in soil testing and the use of fertilizers can make fairly sound recommendations for nitrogen fertilization and use of minor elements on the basis of other information.

Use of fertilizers and soil amendments based on soil tests is much more sound than use based on rule-of-thumb or results noted in a field several years ago.

What Soil Tests Should Be Made?

Before having any soil tests made you should have some specific problem in mind. In other words, it is not advisable to have a soil analysis made with the idea that something might "show up." You may want to know what are the best commercial fertilizers for this particular field when it is planted to alfalfa, potatoes, or corn. If the field is not affected by salt or alkali, you no doubt are aware of the fact and, therefore, would request only an available phosphorus analysis. You may have a field that does not produce well and you are not sure of either the fertility or the alkali status. In that event you might request that the analyst look for salt, sodium, and phosphate. Some sandy soils and others that are high in humus such as peat and muck may lack potassium, so here measurement of available potassium might be requested along with available phosphorus.

If you are planning to drain and leach a piece of salty land, then you certainly will want to know the reaction (pH), amount of salt, degree of sodium saturation, texture, and degree of dispersion. Knowing the amount of lime in the soil would be helpful here as well as in cases where chlorosis has appeared in plants.

There are so many things that a farmer must know, that probably he has not found time to become familiar with many chemical names and tests. It is not necessary that you request specific soil tests so long as you describe your problem adequately. The laboratory technician will make such tests as appear most useful in solving your soil problem.

Interpretation of Test Results

Analytical data must be expressed in chemical terms and numbers, but interpretations of the data along with specific recommendations are always given by the laboratory. Fertilizers and soil amendments are recommended in kinds and amounts that are considered most economical to use. Details on procedures to be followed are frequently given.

How to Take A Soil Sample

The sample itself is important and must be collected in the proper manner. The amount of soil that is ordinarily turned over by plowing one acre weighs about two million pounds so when a soil test measures a soil characteristic on several acres, it must represent a lot of soil. Procedure for collecting a representative sample is given in the following steps:

1. Obtain a shovel, spade, or soil auger and be sure that it is clean—free from any other soil, and especially from any fertilizer.
2. Obtain a clean bucket and pint- or quart-sized container for the final sample.
3. Restrict the area to be represented by one sample to not over five acres. If this area is uniform so far as you know from past experience with cropping it and looking at it; and further, if you intend to grow the same crop over all of this area, you may proceed to take one composite sample. Vegetables in a garden may be considered as one crop so that a uniform appearing garden may be represented by one sample. Walk over the area in a zig-zag fashion taking uniform verticle slices of soil 0-6 inches deep in about a dozen different places rather evenly distributed over the area. Place all of these slices of soil in the bucket and mix them thoroughly.
4. Place about one pint of this well-mixed soil into the container to be sent to the laboratory. If the soil is too moist to mix well in the bucket, it should be dried on a clean canvas or paper and then mixed. **Caution**—heat should not be applied to dry the soil. Just spread it out in a dry place for a

few days. If the soil is so wet that it is muddy or sticks to your shoes and implements, it is too wet to sample and should be allowed to dry somewhat.

5. If the five acre field to be sampled is not uniform, then you must divide it into two or three portions each of which is fairly uniform. Collect a composite sample—one made up of a number of portions of soil from different places on the uniform area—from each of these sections of the field. Your five-acre field may thus require two or three samples. If you consider it impractical to apply different treatments to two or three portions of your field even though the needs are not the same for the field as a whole, then it is best to collect just one sample from the whole field. However, in a case like this it is necessary to take about twenty portions of soil from different spots on the field to make the final sample.
6. A sample from a bad area in a field should also be made up of a number of small portions of soil from different places over all of the area. Along with a bad area sample, it is necessary to send a sample of the normal soil around it. Here again portions of the normal soil from all around the bad spot would be mixed to form one sample.
7. Thus far we have considered sampling only the top soil or that which is turned over in ordinary plowing. When salt or alkali is present, samples of the sub-soil must also be collected. Depths such as 0-6, 6-18, 18-36, and 36-72 inches are usually represented, but sampling need not go below the ground water level. Soil from the same depths out of three or four different holes should be mixed and kept in clean cans or bottles, not in cloth or paper bags. A soil auger is especially useful for collecting sub-soil samples.

Identification and Description of the Problem

You should first number your samples 1, 2, 3 and so on. Then see that the soil depth represented and your name is on each one. The laboratory provides

sample description forms upon request. These forms provide spaces for listing the samples along with the field characteristics of each one. Space is provided for recording the location, slope, drainage condition, crops grown, fertilizers added, crop symptoms, and crop to be grown for each sample. Any additional information you want to add can be placed under remarks. You, no doubt, will find it desirable to keep a duplicate copy of the form sent to the laboratory with your samples.

The Best Time to Collect A Sample

In the fall after the crop is harvested, is perhaps the best time to sample a piece of ground. This is a time when work on the farm is not so rushing and it also allows the laboratory more time to process your samples. Furthermore, you then have most of the winter to plan your work for the coming season and to shop around for needed fertilizers or soil amendments.

Early spring may also be a satisfactory time to sample your soil, provided it is not too wet. If the soil is sampled during the growing season and a nutrient deficiency is found, it is usually too late to get maximum benefit from any fertilizer. There are, of course, special conditions which make sampling appropriate during any time when the soil is not frozen or too wet.

Sampling should always be done well in advance of the time when the information will be needed.

Time Required to Make a Test

About two weeks are usually required to have a soil tested. In special cases the work may be done in less time, while for some involved analyses more time may be required.

Cost of Soil Analysis

The cost of a soil analysis is small compared with the cost of fertilizing or treating one acre with amendments. Charges are made on a per sample basis for each determination. A test for pH costs 25 cents, soluble salt content 25 cents, available phosphorus 50 cents, lime 25 cents, exchangeable sodium \$1.50. A complete list of charges is available upon request. Payments for tests should be made in advance with check or money orders payable to the Soils Laboratory.

EFFECT OF FERTILIZERS

(Continued from page 12)

Recent investigations have indicated the presence of 4 to 4.5 percent cobalt in different crystalline vitamin B₁₂ preparations. The evidence at present suggests that vitamin B₁₂ is the animal protein factor important in the nutrition and well-being of animals and man. Small amounts of this product have been found helpful in the treatment of pernicious anemia. Hay from the unfertilized plots in this test was found low in cobalt.

The hay produced on all the plots is

being fed to pregnant and growing rabbits to determine its nutritive value. Preliminary results have indicated differences in the growth and mortality of the rabbits fed the fertilized and the unfertilized hay. The mortality was higher in rabbits fed the hay produced on unfertilized plots. It is not known whether this difference in biological response is the result of low cobalt or copper content or to the absence or presence of other factors. Similar experiments are being repeated on other rabbits to determine if these same results can be duplicated or confirmed.

Table 2. Yield of Ranger alfalfa on plots treated with different fertilizers, Castle Dale, Emery County, Utah (1st and 2nd crops 1949, irrigated)

Treatments per acre	Yield (air dry basis)	Est. gross cash value‡	Est. increase in value above control
	tons per acre	dollars	dollars
129 lbs. t.s.p.*	2.96	47.36	19.68
258 lbs. t.s.p.	3.97	63.52	39.84
516 lbs. t.s.p.	4.99	79.84	56.16
516 lbs. t.s.p. plus 100 lbs. CuSO ₄	5.15	82.40	58.72
516 lbs. t.s.p. plus 12-15 tons chicken manure	6.10	97.60	73.92
12-15 tons chicken manure	5.41	86.59	62.86
516 lbs. t.s.p. plus trace elements†....	5.39	86.24	62.56
Control, no fertilizer added	1.48	23.68	

* t.s.p. = treble superphosphate, available P₂O₅ 42%, CaO 21.75%. Applied to soil surface in spring 1947.

† 48.4 lbs. borax, 24.2 lbs. cobaltous chloride, 48.4 lbs. copper sulfate and 98.6 lbs. manganese sulfate per acre.

‡ Loose alfalfa hay valued at \$16 per ton.

Table 3. Protein, phosphorus, cobalt, and copper content of Ranger alfalfa produced on plots treated with different fertilizers, Castle Dale, Emery County, Utah, 1948

Treatments per acre broadcast in spring 1947	Average value (air dry basis)			
	Protein	Phosphorus	Cobalt	Copper
	percent			parts per million
129 lbs. t.s.p.*	15.64	0.15	0.11	6.10
258 lbs. t.s.p.	15.14	0.18	0.13	5.60
516 lbs. t.s.p.	14.58	0.19	0.16	8.90
516 lbs. t.s.p. plus 100 lbs. CuSO ₄	14.57	0.18	0.16	16.40
516 lbs. t.s.p. plus 12-15 tons chicken manure	14.64	0.20	0.17	8.30
12-15 tons chicken manure	14.92	0.19	0.11	11.80
516 lbs. t.s.p. plus trace elements†	14.88	0.18	0.28	21.20
Control, no fertilizer added	15.14	0.16	0.06	4.90

* t.s.p. = treble superphosphate, available P₂O₅ 42%, CaO 21.75%.

† Borax 48.4 lbs., cobaltous chloride 24.2 lbs., copper sulfate 48.4 lbs., manganese sulfate 96.8 lbs. per acre.

• INSECTICIDES

(Continued from page 1)

toxaphene. However, it must be clearly understood that the favorable results with these two insecticides were obtained by applying the chemicals during the period when few or no bees were visiting the flowers. In Utah, this means between the hours of 7 p.m. and 7 a.m. Applications in broad daylight must always be avoided. The mortality caused by the applications listed in the table would be much higher in every case if they had been made when the bees were visiting blossoms in the field.

Many growers have tried to observe the effects of these new insecticides on bees. Some have reported that bees were killed. Others haven't been able to find dead bees. Perhaps, then, it would be helpful to explain how the mortalities reported in the table were measured.

In most cases, fields selected for the experiments were out of flight range of bees from commercial apiaries. This fact

assured us that most of the bees visiting the experimental field were from our own hives. The test colonies were placed at the edge of the experimental field a few days before the first application. Locating the test hives close to the alfalfa to be treated made it possible for most of the affected bees that did not die in the field to reach the hives before being overcome. Theoretically, then, most of the bees killed by the insecticide would either die in the field or at the hives. A reasonable estimate of the number killed could therefore be made by counting the number that died at these two places. The complete kill could never be determined since some of the affected bees would fly astray and die. Also, there is no way of learning how many dead bees might be removed by rodents or scavenger insects before our counts were made.

Estimating Numbers of Bees Killed

It is fairly simple to estimate the number of insecticide-killed bees that die at the hives. For at least two days

before an application the dead bees found within a fixed area in front of each hive were picked up at 7 a.m. and counted. The average of these figures is the normal daily death rate at the hives. Following an application, dead bees were picked up each morning as long as the number counted was clearly above normal. The difference between the normal figure and the actual number picked up is the number that died as a result of the application of insecticides.

Estimating the number of bees that are killed in the field is difficult. In fact, we now know that in future experiments of this kind we must improve our methods of determining whether or not a bee has died on the day found. This will probably involve carefully determining just how long a bee will remain "fresh" in the field when killed by each different insecticide tested. However, mortality occurring in the field itself, as we have determined it in tests to date, is probably underestimated. The kills reported in the table are perhaps lower

Duster used in experiments



than they should be for this reason as well as those given previously. To estimate the number of bees that died in the field we carefully examined before and after each application at least 18

ers in the treated acreage. To estimate the number of bees that were exposed counts were made at 11 a.m. and 2 p.m. on at least 18 randomly selected square-yard areas scattered throughout the



W. P. Nye, one of the authors, counting bees in a sample square yard

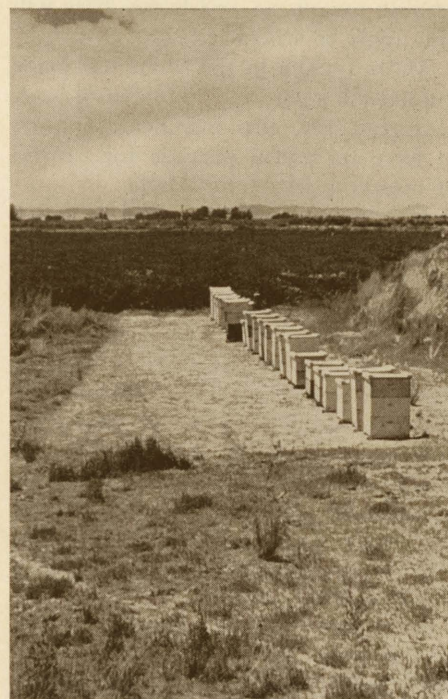
separate two-square-yard areas distributed at random throughout the field. All dead bees found were picked up and closely examined. Those found were classified as "fresh" or "old." The number of fresh dead bees found after an application minus the average number of fresh dead bees found in our pretreatment counts gave us an estimate of the number killed by the insecticide. After an application, counts in the field were made at the end of each day as long as the death rate at the hives remained above normal.

Bee mortality was related to the number of bees directly exposed. By direct exposure we mean contact with the insecticide while actually visiting flow-

ers in the treated acreage. To estimate the number of bees that were exposed counts were made at 11 a.m. and 2 p.m. on at least 18 randomly selected square-yard areas scattered throughout the

field. These counts were averaged. Mortalities given in the table are based on this field visitation. Mortality of bees produced by the various insecticides was largely confined to the two days immediately following an application. Use of dieldrin provided an exception to this rule; bees continued to die in large numbers for 5 days.

In these tests it appeared that only bees actually visiting the flowers (the field force) were affected and killed. However, both dieldrin and parathion might have killed other adult bees in the hive through their contact with the returning field force. The brood was apparently unaffected.



Colonies placed adjacent to experimental field. Dead bees were picked up from cleared area in front of hives

Toxaphene Only Insecticide Consistently Low in Toxicity

Whereas most of these tests were made on a small scale that involved only 2 to 3 acres of alfalfa in bloom, several trials of toxaphene made on large acreages achieved similar results. Large-scale trials of toxaphene were made since it was the only insecticide tested that was consistently low in toxicity to bees and also was useful in controlling harmful insects infesting alfalfa in bloom. Toxaphene provides adequate control of lygus when such control in flowering alfalfa is advisable, provided the proper application of DDT has been made at the right time before the flowering period. It will also give excellent control of grasshoppers at recommended dosages and will control the yellow-striped armyworm, which occasionally infests alfalfa seed fields in bloom. Toxaphene, then, is generally useful to alfalfa seed growers of Utah, and is sufficiently harmless to honey bees for use when alfalfa is blooming, provided applications are made after 7 p.m. or before 7 a.m. Tests of the effect of toxaphene on wild bees are being conducted. Until these are completed it is reasonable to suppose that the above statements con-

cerning toxaphene and honey bees will also apply to wild bees.

Methoxychlor in the single test made did not kill a detectable number of bees. Unfortunately, this insecticide appears to have no useful purpose for control of insects in blooming alfalfa.

In one test as a spray and at a low dosage DDT gave a favorable result, killing only 3.5 percent of the bees. Further studies may show that DDT can be safely used as a low-dosage spray. However, a factor such as increase of spider mite populations when DDT is used more than once on a given crop may prohibit even low-dosage sprays of this insecticide during bloom. Incidentally, DDT usually repels bees for several days, and kills by this material would probably be much higher without this repellency.

Chlordane has shown great variability in our tests. If this variability can be explained by differences in the material, it might also have a place in controlling insects in blooming alfalfa. High kills by chlordane were obtained in 1947 and 1948 but not in 1949. Further studies of this material are justified.

At present, lindane, benzene hexachloride, parathion, aldrin, and dieldrin appear to be too toxic to bees to warrant additional testing for use on seed alfalfa in bloom. Dieldrin is particularly toxic. Note that in this instance the estimate of dead bees exceeded the estimate of

Table 1. Mortality of honey bees produced by various insecticides when applied* to fields of alfalfa in bloom, Logan, Utah, 1947-49

Insecticide applied as a spray			Insecticide applied as a dust		
Name	Dosage of active ingredient	Bees killed	Name	Dosage of active ingredient	Bees killed
	lbs. per acre	percent		lbs. per acre	percent
Toxaphene	2.3	0.0	Toxaphene	1.9	8.0
	2.8	1.7		2.3	0.0
				2.3	3.6
				2.4	0.0
				2.8	2.0
				3.6	1.6
Methoxychlor	1.5	0.0			
DDT	0.44	3.5	DDT	0.48	18.7
				0.9	28.0
Chlordane	1.0	10.0	Chlordane	1.0	1.3
	1.25	6.4		1.0	3.0
				1.1	23.0
				2.8	48.0
Lindane	0.43	17.3	Benzene hexachloride		
Aldrin	0.53	19.0		3.2†	19.2
Dieldrin	0.56	107.1	Parathion	0.23	40.0
				0.58	32.5

* Applicatons were made during hours when bees were not in the fields.

† This dust contained 0.32 lbs. of gamma isomer per acre; lindane is 99 percent gamma isomer.

bees visiting the field by 7 percent. It is known that a few other experimental hives were within flight range of this

field. Some of the dead bees found in the treated acreage undoubtedly came from these other colonies.

RING SPOT

(Continued from page 3)

ling trees that are used as rootstocks for cherries. Shoots arising from virus-free buds placed on ring-spot-infected rootstocks will usually show typical ring-spot-leaf symptoms.

It has been demonstrated repeatedly that ring-spot-free trees grow more vigorously than normal appearing infected trees of the same variety. The effect of the virus in stunting tree growth and reducing yields is of great economic significance because of the high incidence of this disease in all stone fruit orchard regions.

Ring spot virus causes dieback, winter killing, and bark necrosis in peach trees in addition to ring spot leaf symptoms. Four-year old Elberta peach trees that were inoculated with the ring spot virus by inserting infected buds in the

main branches are shown in fig. 2. The infected branches died during the winter following inoculation. Large bark cankers developed on the trunks and other main branches. Severe winter killing in peaches has been produced many times by ring-spot-virus inoculations at the field experimental plots at Farmington. Many peach trees have been permanently and severely injured and many have been killed by these inoculations. It seems likely that much of the dieback and winter killing in Utah peach trees can be attributed to infections caused by the ring spot virus.

Transmission and Spread

Since infected trees usually do not show leaf symptoms after the initial onset of the disease, they have commonly been used as presumably virus-

free budwood sources for propagating nursery trees. This has resulted in the wide-spread distribution of the virus in all stone-fruit-producing areas. Even though nurserymen may use virus-free budwood sources, the virus may still be disseminated in nursery trees if the rootstocks carry seed-transmitted ring spot virus.

It is highly probable that insect vectors (which are yet unknown) are spreading ring spot virus from diseased to healthy trees in the orchards.

Control

There is no method now known for freeing infected trees from the ring spot virus. Little is known about the rate of spread in commercial orchards. If the spread of the virus in the orchards is slow, then the disease can prob-

ably be effectively controlled by planting only ring-spot-free trees in new orchard plantings. Reliable indexing methods have been developed and used to establish sources of virus-free budwood and rootstocks. There is no way that the orchardist can identify ring-

spot-free nursery trees. Such trees can only be obtained, with any degree of assurance, by purchasing stock from certain nurseries in the United States that are using only ring-spot-virus-free budwood and rootstock sources. The planting of virus-free trees obtained

from these sources is the only control method now available. Any program of diseased tree removal would be economically unsound because of the high incidence of the disease and because of the difficulties of diagnosis.

MOUNTAIN MEADOWS

(Continued from page 11)

Table 2. The effect of commercial fertilizers on the yield of meadow hay (Yields in tons per acre)

Treatment*	Native meadows				Reseeded meadows	
	Kingston	Mt. Carmel	Greenwich	Gravel Springs	Altona	Circleville
	tons	tons	tons	tons	tons	tons
1 No treatments	2.23	1.33	1.77	1.15	1.06	1.32
2 P ₁	2.47	1.26	1.81	1.22	1.26	1.87
3 P ₂	2.59	1.18	2.08	1.33	1.02	2.20
4 N ₁	3.24	1.34	1.95	1.49	1.15	1.55
5 N ₂	3.77	1.64	2.04	1.95	1.21	1.94
6 N ₂ P ₂	3.04	1.67	2.25	2.14	1.61	2.87
7 N ₂ P ₂ K ₁	3.49	1.63	2.30	2.31	1.92	2.90

- * 1. Check
2. 150 lbs. treble superphosphate
3. 300 lbs. treble superphosphate
4. 150 lbs. ammonium sulfate
5. 300 lbs. ammonium sulfate
6. 300 lbs. treble superphosphate plus 300 lbs. ammonium sulfate
7. 300 lbs. treble superphosphate plus 300 lbs. ammonium sulfate plus 100 lbs. muriate of potassium

ments are made, the farmer should fertilize several test strips on his meadow and observe the results. By follow-

ing this procedure he can decide whether or not a profitable increase in yield can be expected.

RETURNS FROM WOOL

(Continued from page 13)

pound clean basis for a lot or any part of a lot tied with sisal binder twine. On tender or damaged grease wool the discount is twenty-five cents per pound clean basis. Stained wools are discounted from a minimum of two cents per pound clean basis for slightly stained up to a maximum of twenty-five cents for heavily stained wools. These instructions emphasize the need for using care in the proper preparation of wools if maximum prices are to be received.

Many range operators are making an effort to prepare their wool to meet these requirements. However, the widespread use of portable shearing equipment has increased the difficulty of preparing wool clips properly. The amount

of dirt, heavy tags, and other foreign materials in the wool is often excessive. This may be attributed to lack of clean shearing floors and shearing pens. Even with portable shearing units a little care and preparation on the part of both the shearing crew and the operators can overcome this source of contamination.

Too often black fleeces are not separated from the white wool. Black sheep should always be sheared last and the black wool and tags sacked separately. There is room for improvement in the tying of fleeces. A poorly tied fleece is unattractive and makes later separation of fleeces difficult.

It is recognized that many times the shearing date is beyond the control of the operator, however, where the lambing season is late, it is usually advisable to shear prior to lambing. Wool from ewes sheared prior to lambing contain less foreign matter, is more attractive, and contains fewer "breaks" in the fiber.

Each wool bag should be properly identified. A neat legible brand on the wool bag lends distinction to the wool clip whereas poorly marked, carelessly branded bags are unattractive and suggest that the contents may be prepared in the same manner. If wool is to be stored for some time prior to the date of

shipping or selling it should be placed in a rather dark, cool shed to prevent undue loss of moisture and the deterioration of manufacturing quality.

Learn Market Grades

Wool growers should learn as much as possible about the market grades and classifications of wool. Sometimes it is difficult to learn how an individual clip has been graded although most marketing agencies place this information on the sales account records. Some marketing agencies conduct short courses to teach the grower the different grades and proper methods of wool preparation. The grower should use these facilities whenever possible.

The shrinkage of wool is important in determining its market value. Assume that we have two clips of wool of similar quality with a clean value of \$1.50 a pound. If one clip has a shrinkage of 60 percent and the other of 65 percent the grease values would be 60 and 52½ cents, respectively. This is a difference of 7½ cents between the two clips or a total of \$750 on a 10,000 pound clip of wool. The wool grower selling at the 65 percent shrinkage would have to produce 1428 more pounds of wool to

receive the same returns. Figured in another way the operator selling at a 65 percent shrinkage would have to average three-quarters of a pound more wool per sheep from a band of 1000 sheep to equal the returns from the clip sold at 60 percent shrinkage.

This example indicates the necessity of learning as much as possible about the shrinkage of wool before it is sold. Considerable work has been done by state and federal agricultural agencies to assist the wool grower in obtaining information on the shrinkage of his wool. The Utah Agricultural Experiment Station found the shrinkage of range wool to be higher than similar wool from farm fed flocks. There is also a marked variation in shrinkage from wools of similar type in different areas and in different years. It has been found that longer fiber wools tend to be lower shrinking. The length of fiber is more important in the shorter, finer wools than in the coarser grades of wool. Although there are a few guides to indicate high and low shrinking wools, it has been found advisable to obtain a shrinkage figure on each year's wool clip.

Determining Shrinkage

A major difficulty encountered in obtaining shrinkage information has been the development and acceptance of a reliable sampling technique. Within the past five years there has been a gradual acceptance of the **core test** as a means of determining wool shrinkage. All grease wool purchased through the Production Marketing Administration Wool Purchase Program must be core tested. Many wool handlers and wool manufacturers are now willing to accept this method of determining wool values. Experiment Station workers have shown that the core test properly used gives results that are close to those obtained in mill scouring operations. One of the disadvantages of the core test is that it is not adapted to the sampling of small lots of a few bags of wool. Utah studies have indicated that on small lots of wool either the use of composite samples or individual side samples will provide a fairly reliable guide to the shrinkage of these wools. The wool grower should avail himself of the opportunity to obtain a shrinkage figure on his wool clip if he is to be informed fully of the value of his wool.

Some Trends In American Agriculture

By GEORGE T. BLANCH

THE American people, both farm and non-farm, are today aware as never before of a fields governmental activity vaguely referred to as agricultural programs, agricultural policies or farm problems. These activities are constantly before the public in discussions of such things as the adequacy of the food supply, conservation of agricultural resources, price supports, storage of farm products, production controls, reclamation, and dozens of others. It's highly desirable that the public be informed about these activities because all people are dependent upon agriculture for food and fiber, and also each person must bear at least a small part of the cost of these activities.

However, in studying the need for, and the effects of, the various agricultural programs, it is desirable that the public, including individual farmers,

understand some general long-time trends in American agriculture. These trends, in large measure, have created the situations or problems that the farm programs are attempting to solve. Therefore they cannot be ignored in any intensive study of farm problems and programs. The effects of these trends are much broader than the specific programs for agriculture; they are related to all social, economic, and political aspects of the American way of life.

Cropped Acreage Has Not Kept Pace with Population

It will doubtless surprise many to learn that although the total population of the United States has increased from less than 92 millions in 1910 to 150 millions at present, the total acres of harvested cropland have remained almost constant. Since the balance between agricultural imports and exports has not greatly changed, this means

that a given acreage of cropland is supplying approximately 60 percent more people. It is not exactly the same acreage, as during the interval between 1910 and 1949 a considerable area of cropland was transferred to other uses and was replaced by a similar acreage of land. The new cropland was of course not often in the same area as the land that went out of production. In general, the harvested crop acreage has increased in the western and decreased in the eastern states. Between 1920 and 1945 harvested crop acreage in the three middle Atlantic states of New York, New Jersey, and Pennsylvania decreased from 17,020,003 to 14,441,470 or more than 2½ million acres, which is just about twice the present area of cropland harvested each year in Utah.

Production Increased with Population

With the cropland remaining constant and population increasing, other

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important changes must also have been taking place. Statistics from the United States Department of Agriculture show that farm production for sale and home use kept pace with the population. With the average of 1935-39 considered as 100, the index of production in 1910 was 79 and in 1946, 135. This was a slightly greater increase than for total population. The increase in production was distributed over the entire period though a somewhat greater than proportionate part has taken place since 1940.

This increase in production was not entirely in increased yields per acre of specific crops though such increases were significant. Basic to the increases in total production is the work of plant and livestock breeders in the agricultural experiment stations who have produced higher yielding varieties and strains of plants and animals. The shift from animal to motor power on farms has also released a large area of land for the production of products for human consumption that formerly was required for feeding work stock. Shifts from extensive to intensive crops—partly in response to changes in dietary habits of people—have also been a factor. Advancement in the technology of crop and livestock production including the use of much more commercial fertilizer, better balanced rations for livestock, and better management generally have all been important. Better than average weather the past several years was a factor in the unusually large increase during this period.

Fewer People on Farms

In spite of an increase of about 70 percent in the volume of farm production since 1910 there has been a decrease from 32,077,000 to 27,776,000 people living on farms. This is a decrease of 4,301,000 or more than 13 percent. In 1910, 31 percent of the gainfully employed were working in agriculture. By 1930 this percentage had been reduced to 21 and at present is estimated at about 16 percent, or about half what it was in 1910. Notwithstanding this great reduction, in many parts of the nation today the large number of people living and working on farms is in excess of the number needed to do the required work

and constitutes one of the major social and economic problems. The production per worker in agriculture has just about doubled since 1910.

Increased Mechanization

This phenomenal increase in productivity per man is closely associated with the increased use of machinery—particularly power machinery and equipment. The latest information available from the Bureau of Agricultural Economics shows that for all farms in the United States about 12 percent of the total fixed investment (land, buildings, livestock, and machinery) is in machinery. This is approximately 3 times what it was in 1910. That there have been great changes in the mechanization of agriculture is well known, but the full effects of such mechanization are probably not so well known even to many closely associated with the industry. Mechanization has not been uniform over all types of agriculture. Neither have the effects been uniform in all cases where it has taken place.

Commercialization of Agriculture

The above-mentioned trends are all interrelated with another which is evident to most people. This is the trend toward more commercialization of agriculture. This means production for sale rather than for use by the farm family. In pioneer days in the United States and in many countries of the world today (China is a good example) the major part of the products of the farm is consumed by the farm family. Last year in the United States the value of farm products used on farms was only about 10 percent of the total production. This means that 90 percent was sold. In 1930 about 85 percent was sold and 15 percent consumed in farm homes.

Another aspect of this trend toward the commercialization of agriculture is reflected in the cash receipts and expenses. The cash farm income per person in agriculture increased two and one-fourth times between 1910 and 1948—after adjustments are made for changes in price levels. Comparable data are not available to show the exact increase in cash expenses, but general data indicate the same trend though not quite so sharply upward. Such items

as power machinery, electricity, commercial fertilizer, and certified seeds all involve cash expenditures that were not present under a self-sufficing type of production. Along with the increase in farm cash expenses is an increase in family cash living expenses. Food, clothing, furniture, equipment, and services that once were provided at home are now purchased.

The Farmer Becomes Increasingly Important

What have the afore-mentioned trends to do with agricultural policy and farm programs? The implications and effects of these trends are as broad as our economic and social life. Space will permit mentioning only a few. First and from the public point of view, a larger and larger part of the total population is dependent upon a smaller and smaller segment of the population for food, an indispensable necessity. Should anything happen to cause or prevent that small segment from producing and marketing as usual, many people would be inconvenienced or even made to suffer. Again since these trends result in a constant stream of people, mostly young men and women, moving from farms to cities and employment in non-farm activities the public is vitally concerned. These young men and women are largely educated and trained in rural schools often times for vocations in agriculture that they never follow. The implications of these situations are great but cannot be followed further in this paper.

Successful Farmer Must Be Well Trained in Addition to Having Good Land

From the point of view of farmers one of the most important results has to do with the selection of land that can be profitably used. For all except the most extensive types of farming the quality (roughly measured by productivity) is becoming more and more important. Or, in other words, the difference in economic value of low and high producing land is constantly getting wider and wider. Or to say the same thing in still another way, it is becoming more and more difficult for the farmer on low producing land to make expenses and provide an accept-

able level of living for his family. This effect has been partially masked during the past several years of prices more favorable than normal. With a return to normal or below normal price relationships, it will be more evident. Similar in results is the difference in quality of farm managers. The changes are placing more and more of a handicap on the farmer who is only a workman. Technical training in the principles of plant and animal production and in the production and in the business management of the farm are important as never before. A poor manager may get by if he has a good farm, and a good manager may get by on a relatively poor farm, but the level of living of the farm family is likely to be low in either case.

Volume of Farm Business Must Be Large

A third result of the trend discussed above is that a full time farmer in order to be successful must do a larger volume of business. Competition in agriculture is such that farmers are paid largely for the productive work that they do. The farm that under a man and animal-powered economy was adequate to keep a family fully employed at productive labor is too small with modern machinery. Either more land is needed or changes in the type of farming made, so as to do more business on the same land.

Many other specific effects of the trends in agriculture could be pointed out. However, if we assume a competitive economy, they all add up to the fact that for full-time farmers in the future, competition for survival as well as for success will be tougher and tougher. The premiums for the superior farmer are becoming larger, the penalties for the inferior farmer more drastic. Also the degree of success as a farmer is more closely related to how well the farm family lives. The rewards of a high level of farm living go to the families on farms with high producing soil, and with managers familiar with the scientific principles underlying crop and animal production and well-founded in farm business management.

EFFECTIVE MARKETING OF LIVESTOCK

By D. A. BROADBENT

Effective marketing of livestock is one of the most important problems confronting livestock producers today. Many groups are concerned with this business, and every group is interested in seeing the job done so that its particular interest is cared for. Producers, dealers, packers, wholesalers, and retailers all are affected by the way and the efficiency with which lambs are marketed. In any analysis of lamb marketing costs, we must recognize a few basic situations.

First, regardless of where individual ranchers sell their lambs, essentially 30 percent of them will be purchased by the representatives of four large packing companies. Active and real competition for lambs under these conditions can be hoped for but may not necessarily be achieved. Individual action is powerless to combat this situation. The bargaining hand of the producer has been weakened by striving to dispose of his livestock as cheaply as possible rather than by putting the animals in the hands of an agency who can more nearly represent buyers in terms of market skill and knowledge of current market conditions. So long as individual producers are willing to deceive themselves into thinking that they can meet the professional lamb buyer on equal terms, lambs will fail to sell for their full value. Lamb prices are not determined automatically by the unflinching balance of supply and de-

mand. Supply and demand are reflected only through individuals who represent the market agencies and those who represent the producers; in such a meeting those best informed and best organized will have the advantage.

Second, in our efforts to reduce marketing costs we must recognize what those costs are. If all the costs normally incurred by the producer in selling his livestock, that is, transportation, commissions, yardage, were added together, they would not be equal to the normal profit the retailer receives for handling the meat. The retailing margin is normally five to six times greater than the farmers' direct costs of marketing; and processing is more than twice that of costs paid directly by producers. Cost of transportation of livestock are more than 50 percent greater than other marketing costs. These must be paid by some one regardless of where livestock are sold. Group action of producers is essential to meet the transportation problem. Transportation tariff rates have, in many cases, passed the point of diminishing returns.

There are more opportunities to cut nickels from the costs of marketing after livestock are sold to packers than there are to cut pennies from costs up to the packer. The producer has a much better chance of increasing his net returns by getting what his livestock are worth by more effective selling than by the reduction of his costs.

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